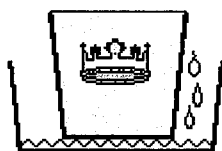


"Eureka! Eureka!"

The king of Sparta decided that he needed a new gold crown, which he could make from some of the booty he had gotten from his victories. The king gave his most reputable goldsmith a small brick of gold that measured 3 x 6 x 8 cm and weighed 2,765 gms, and ordered him to turn it into a new crown. Several weeks later, the goldsmith delivered the crown to the king, who weighed it and found it to be exactly 2,765 gms. The king was delighted, until he had a dream that the goldsmith had taken some of the gold and diluted it with some base metal to make up the difference in weight, and kept the unused gold for himself.

The goldsmith had thought of this, but decided to risk his life on the fact that no one could calculate the volume of the crown, and that the king would not melt his crown back into a measurable block so that its density could be calculated. The goldsmith was right: the king didn't want to melt down the crown. Nevertheless, the king wanted assurance that he was not dooped, and gave public notice of a prize to anyone who could determine the volume of his crown.

As legend has it, Archimedes was in the baths relaxing and watching the goings-on around him. He noticed that whenever someone got into a tub the water level rose. Suddenly an idea came to him: the concept of the conservation of matter. Total volume = volume A + volume B. He jumped up and ran naked down the street towards the palace shouting "Eureka! Eureka!", which means "I have found it" in ancient Greek. Now the king was not shocked to see this naked man knocking at his palace door because most men in those Spartan days wore little or nothing in that hot and humid climate. So the king invited Archimedes in, and soon the two were bent over a table upon which was a bucket, which was absolutely full to the brim, inside of another empty bucket. As the men slowly lowered the crown into the inner bucket, a little water spilled out into the outer bucket.



Finally, the whole crown was submerged, and the inner bucket was carefully lifted out so that no splashing occurred. The water in the inner bucket was found to weigh 169 grams. Then Archimedes, who up to then was a nobody-geek in this city full of athletic warriors, explained to the king that the original block of gold was 144 cubic centimeters in size, which would displace 144 grams of water. Thus the new crown has more volume than the original gold brick, but weighs just the same. The goldsmith must have sliced off a piece of the gold brick and kept it for himself, then added something else to the remaining gold being careful to add enough of the base metal to make up the required original weight.

During the ensuing celebrations at which the goldsmith received the brunt of Spartan military prowess, Archimedes was bestowed the honored title of Physicist Royale, and received the promised reward. (Alas, a short while later, rival city-state Athens defeated Sparta. An Athenian soldier broke down Archimedes' office door and told him to put his hands up. But as Archimedes did so he pointed at his desk and told the soldier: "Don't disturb my circles." For that indignation, the soldier thrust a spear through Archimedes. (No, Archimedes' screw is something else!)

Anyway, back to the crown: suppose the diluting base metal was lead (specific gravity = 11.3), how much gold (specific gravity = 19.3) did the goldsmith steal from the king? (Answer: About 16 cubic centimeters of gold, which weighs how much in grams? And in troy ounces (12 oz/lb), and is worth how much today?